Session 8C: Toxics in Marine Mammals

Questions & Answers

Richard Addison
Q: The seal population, of course during this period, has been expanding so that 400 ppt number may not in reality be causing a problem for them. If the dioxins do decline to close to zero, is the remaining toxic equivalent TEQ level going to be above 200?

A: The first part of your question is an interesting one. We have dealt with the same kind of question in looking at eastern Canadian seals, and fundamentally as well as what you are asking is whether if the population is growing, is that essentially diluting the burdens that we see in the animals. The short answer is no, because those animals as individuals are still feeding on the same kind of diet as they fed on four years ago, so what you would be seeing with an expanding population is a general shift of dioxins and furans up into a higher trophic level in terms of total burdens. But I don't think that is going to accounted for in terms of changes in concentrations just because the diet hasn't changed. The second part of your question is what accounts for the total toxic equivalence if the dioxins and furans do decline. The whole question of basing health assessments and toxic equivalence is a little nebulous because we tend to base our assessments on the toxic equivalence of the things that we arbitrarily decide to measure and include in the total estimation. Health Canada uses only dioxins and furans in that total estimation, and the data I have shown you are based solely on dioxin and furan toxic equivalency factors. If you start adding in the toxic equivalency factors from monoorthochlorylbipheyls, which usually are the biggest single source of toxic equivalence in the residues that we see in these animals. You would find that the monoortho CBs account for more than 50 percent of the total toxic equivalency. But from a regulatory or advisory standpoint, those numbers are not included in Health Canada's recommendations. If they were going to be included, Health Canada would have to adjust the recommended dietary intake from 20 ppt up to 40 ppt.

Q: What are your thoughts on the effluents from the pulp mills and the fact that the background site was more heavily influenced from atmospheric effluents and are you thinking that the sites closer to them were more affected by the water discharges or the atmospheric discharges?

A: I don't know how much I can go into the geography of the Strait of Georgia, but there are six mills around the Strait of Georgia. I have lumped the seals together as Strait of Georgia seals versus [more locally identified] seals. That's probably not completely fair, and one of the population biologists would be better able to answer this than I can, but I think that the seals tend to range over a relatively limited distance of 15 to 30 kilometers. So if we had more samples and enough resolution, we might be able to see spatial variation even within the Strait of Georgia depending on what seal groups we had looked at and how close they were to the pulp mill effluents. Having said all that, the way the effluents came out in the 1990s is that the dioxins came out discharged aqueous effluents but associated with a huge amount of particulate matter because pulp mills just put out a lot of particulates. With all that sediment out in the immediate vicinity of the mills themselves but a lot of it was also suspended and smeared over larger areas of the Strait of Georgia, and it's difficult to generalize from mill to mill or from point source to point source because in the some of the mills the ones that discharge into an enclosed basin, all that stuff probably remained in [the basin] itself, but for the mills at Elk Falls, Palo River, and so on, I should imagine was fair distribution around the Strait of Georgia.Your question is really one of how closely we can resolve spatial differences and the short answer is we can't without doing a lot more sampling. For purposes of this, what I want to simply to do is make very large scale broad brush comparisons.

Q: I was really interested in your comment that the females can excrete toxins through lactation, and I was wondering if there had been any studies on how that affects the seal pups and if their immune systems are significantly more compromised given that they are smaller and may be weaker, and also if that might potentially skew any correlation between the decrease in toxins being put into the water and what you see in the populations, if it's being passed on from generation to generation?

A: I think I will let Peter discuss the biochemistry of the immune system. What I can tell you is that if you look at the populations of seals, for the gray seals in eastern Canada, Nova Scotia to a lesser extent the harbor seals out here, in both those cases the populations have been expanding steadily at about 12 percent per year since measurements started to be made, which is probably 15 to 20 years ago. The upshot of that is that if there is an affect on individual seals in terms of disruption of their immune function and there may very well be such an effect, it seems not to be showing up at the population level at least in those two populations. There are other populations where arguably there is an impact, perhaps the Baltic ring seals for example. Your more general point about impact on the pups, if you are a male pup that's tough, you are going to live with your mother's burden of organochlorines plus all the other ones you have picked up throughout your lifetime; if you are a female pup, there's a good chance that you can actually pass on some of what your mother to your offspring.

John Calambokidis
Q: In wondered if you could comment on any indicators of the health of the Puget Sound, the south Puget Sound populations that you have been studying?

A: Well generally when you look at how these harbor seals have been doing really since the late 1970s, Puget Sound harbor seals have been increasing at a very rapid rate. The harbor seals populations were depressed by hunting, active bounty program that was in place in the 60s, so the populations were rebounding from that. The only sign we see of some contaminant related problems does stem from what was going on in the 1970s. When you look at when restrictions on hunting and protection occurred, it occurred in the 60s and very early 70s, yet populations in areas like Gertrude Island didn't start showing a sharp increase in numbers until the late 1970s. So there could have been an effect on reproductive occurring at that time period, and the early '70s was a period when a researcher and some of the early work that Steve Jeffries was involved in reported high rates of premature birth and birth defects on harbor seals. It wasn't possible to directly link that at the time to contaminants, but that could well have been an contaminant effect. Now, we are probably out of the area where reproduction is being affected but into more of the area where Peter has been studying. The potential for immune competence effects…and that might be something you don't see slowly but might be more reflected of the response of the population challenged by a disease epidemic. So right now, the populations are doing well. There's also the chance that we have studied southern Puget Sound harbor seals in areas of highest contamination like central Puget Sound. Those were areas at least in the 70s and 80s, harbor seals were very rare, and there's a chance where contaminant levels were high enough that the populations were prevented from recovering in some parts of the Sound.

[Question not recorded.]

A: In 1984, we tried to do a study where we compared areas of Washington State where we anticipated and later was shown to be high levels of contaminants versus other areas with low contaminants, and we compared things like population trend, pup mortality/reproductive rate and at that time our lower contaminated area actually had a higher pup mortality than our more contaminated area. So, again, by the mid-80s we were not seeing a clear cut such as mortality or direct effect on reproduction that we could link to high and low contaminated areas. Teasing apart the subtle effects, like immune suppression is much harder to do, but that may have been occurring in the 70s. We didn't see evidence of occurring since the mid-80s.

Robert Grove
Q: I think that there was some suggestion that river otters from British Columbia was a reduced baculum size, which was associated with higher organochlorine concentrations. I was wondering if you had seen anything like that in the study?

A: I haven't actually looked at the data to that extent yet, but what we did find in the Columbia River and that's how we started looking at the Canadian stuff with Dr. Elliott up in Vancouver was that we did see a progression as the concentrations of PCBs in certain OCs went up the size of the baculum in the zero-aged animals went down and, in fact, the concentrations of PCBs you see in the Bremerton area are very high compared to what we had in the Portland area where we have some Superfund sites and they are in the

under 10-part per million concentration level. We did see non-externalized gonads, short baculums, some renal A genesis that was occurring. Whether that's from the contaminants or not, we are not certain, but they all happened in the same site, so it leads to the question of, what's going on? and we had John start looking for these things in the samples he was looking at, too, as well as with me. But we don't have any more on the lower Columbia because they are much more sensitive to these compounds and they don't exist.

Open questions

Q: A question for those of you who are looking at trends, I'm struck by the thought that we think we have turned off most of the sources for the contaminants that have been discussed this morning. How long do you think these compounds are likely to remain an issue?

A: A long time, and that is especially a caveat and why I tried to show different kind of scales. You look at temporal trends because even the evidence of decline exists in Puget Sound more that the main factor that is probably occurring is not that these contaminants are going down on the global scale, what we are seeing is, for PCBs that are stable, they are just becoming more evenly spread out and distributed and areas like open ocean and areas away from contamination are probably going to see increases as you get that more even distribution.

A: I would agree with that with the added observation that I think that over a very long period what you are going to see is most of these things migrating into either the Arctic as a result of sequential evaporation and condensation of progressively colder environments, and also marine sediments because I think once they get into marine sediment and once they buried under fresh sedimenting material, they tend to become relatively unavailable biologically. So your question of how long they are going to stay depends very much on where you look at them. And there was a paper, maybe 10 years ago, dealing with PCBs which asked very seriously whether some PCB components would ever go away and I think the conclusion of that author at that time was that there was some very refractory congeners that simply would not disappear.

Richard Addison

Q: Intrigued by the difference in the pulp mill compounds in British Columbia and Puget Sound given that we have pulp mills down here. I am wondering if you are at all knowledgeable about these differences between the pulp mills in British Columbia versus the ones down here that might explain the difference?

A: The short answer is no. I think that one of the things we are learning is that the main culprit at least as dioxin contamination of our Strait of Georgia seals was concerned, was I think the practice of preserving wood chips with pentachlorophenol before they were processed. And once that was discontinued, that made a fairly dramatic change in the emissions of dioxins from the pulp mill effluents. I don't know what the practices were down here, whether wood chips were preserved with pentachlorophenol here but that would be one factor. The second one is the use of chlorine as a bleaching agent up until about 1990, that was discontinued and chlorine was replaced by chlorine dioxide, and although that still has some effects from producing products, it is generally a good bit less reactive that elemental chlorine.

Q: I am assuming that the use of PCBs arrived in Vancouver similar to what went on in Puget Sound. What is the difference? Is it the difference between Strait of Georgia and the Puget Sound and the function of those two bodies of water? What it is the difference with PCBs, assuming there are similar use patterns?

A: I don't know if there were similar use patterns actually. I don't know a lot about PCB use in the Vancouver area, but I'm not sure. My guess would be that probably we didn't see as much PCB use in the Vancouver area as you did in Puget Sound. To that extent, the source function may have been a little bit different. The other point is that the PCBs that we are seeing now cycling around the environment and young seal pups I'm pretty sure are PCBs that are being continuously released from sediments of contaminated terrestrial soils that have been accumulated there over many years. The distribution pattern of PCB components should be similar in the two groups then and I don't honestly know why they are

different. Colin Gray sitting right beside you represents an organization that can tell you about PCBs in Canadian environments.

Panel
[Question not recorded.]

A: Probably in the neighborhood of 70 to 90 percent of the PCBs that are out there are still contained in landfill sites or contaminated areas that might eventually end up in the ocean. So only a small amount of the PCBs ever produced that are still in storage or in some form of storage terrestrially have made it into the environment. A couple of things we done in British Columbia, we estimated that the total quantity of PCBs in the killer whales—the southern resident killer whales and northern resident killer whales—was about 10 kilograms. And that is in a population of about 300 animals. It doesn't sound like a lot, but that's quite a bit for 300 animals. I also did a calculation based on some of our work with harbor seals and estimated of the 30,000 harbor seals living in British Columbia, it was also about 10 kilograms of PCBs. We also did a calculation, which I presented three years ago and I have forgotten the numbers, but for Puget Sound harbor seals in the area of 15,000 to 17,000 and that was, don't quote me on this, I think it was around 15 or 20 kilograms of PCBs.

Richard Addison
A: We have done that kind of with the envelope calculation. There is no question that the two big reservoirs in the environment for things like PCBs are first of all, sediments and soils, and secondly, the atmosphere. And clearly the partitioning between the two depends pretty much on the physical chemical characteristics of the compounds you are talking about. The amount that is tied up in the lipid of something like seals is pretty low. I did a similar kind of calculation for Salo Island gray seals and guestimated [sic] there was somewhere between 5 to 10 kilograms there. And when you look at global production of PCBs, which at its maximum in the early 1970s was something like 100,000 tons, clearly the amount that's tied up in marine mammals is neglible.

Q: Is it true that with this marine mammal data is not used in the RI/FS process for CERCLA cleanup, and if it's not used, why isn't it in the ecological risk assessment process?

Panel
A: It basically is the old paradigm we have been using in risk assessment and looking at what acceptable risk is and having site-specific data and information, and quite frankly some of the regulatory agencies haven't been willing to go there, thinking outside of the box, away from the paradigm, and how to interpret some of the marine mammal data is, some of the data was collected actually in the late 60s early 70s. What that data meant, I think, really has not been well understood until most recently, as far as immunotoxic effects and what type of risks these animals. Sure they are a big piece of blubber if you are a cetacean or pinniped and they are going to collect a lot of organochlorines. What does that mean, the 'so what' question? Immunotoxicity-wise or what have you, reproductive or what have you, and that hadn't been looked at as much in the past. So I think some of the regulatory agencies just haven't thought outside the box and been able to attack that paradigm or sacred cow and address that in that's something I know our agency is interested in. And also in the monitoring program, my point is after a Superfund cleanup, looking at an aquatic mammal, a marine mammal, or aquatic receptor, even a bird, to see some of the monitoring programs after a cleanup we are looking at….is the sediment staying clean or is the cap failing or in fact, are the fish getting better? Are the salmon or rockfish, or what have you, over a long period of time cleaning themselves up? I am really trying to get some of the regulatory agencies to look at some of the higher level of trophic organisms as receptors as well. Sure you can't get a statistically valid number of eggs or samples and that's part of the…you can't take that many marine mammals or birds for sampling purposes… so statistically it makes a big difference. But for my agency, even seeing a downward trend after spending millions if not billions of dollars on cleanup I think would be worthwhile and make sure we are doing the right thing.